PRIVATE SCHOOL ENROLLMENT, THE TIEBOUT HYPTOHESIS, AND PUBLIC SCHOOL EXPENDITURE EQUALIZATION POLICIES

BY

AMY BETH SCHMIDT

A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1989

ACKNOWLEDGMENTS

There are a number of people who have helped me with my dissertation. My committee, Jon Hamilton, Dave Denslow, Bob Emerson, and especially my chairman, Larry Kenny, who never let distance be an issue. Former economics faculty members Stephen Cosslett, Lucia Dunn, Walter McManus, and Nadja Zalokar, who were all a great help in the early stages of this thesis. My husband, Torsten, who gave me invaluable support and helpful advice from the beginning. Finally, my parents, who gave me the gift of an education.

TABLE OF CONTENTS

Abstract of Dissertation Presented to the Graduate School of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

PRIVATE SCHOOL ENROLLMENT, THE TIEBOUT HYPOTHESIS, AND PUBLIC SCHOOL EXPENDITURE EQUALIZATION POLICIES

By

Amy Beth Schmidt

August 1989

Chairman: Lawrence W. Kenny
Major Department: Economics

A theoretical model is developed in Chapter 2 that provides testable hypotheses regarding secular and religious private school enrollment. The foundations of the theory lie in Downs's median voter model and Tiebout's hypothesis of local public goods provision. The theory predicts that income variation within a school district determines the percentage of students in private school. This is a departure from the existing literature, which relies on average or median income to explain private school enrollment.

The local market for education is the Standard Metropolitan Statistical Area (SMSA). A four equation model is described in Chapter 3 and estimated in Chapter 4. The sample consists of 134 SMSAs' average school districts. The dependent variables are the percentage in private school, expenditures per pupil, income heterogeneity, and the number of schools districts. Together, these equations model the

relationship among SMSA characteristics, Tiebout sorting, and the public/private school choice.

The equalization policies that are examined are the limits on local property tax rates and revenue increases and foundation programs. These policies restrict local control over the quality of public education. The first two are expected to increase private enrollments. Lump sum aid is not expected to affect enrollment, as it acts like an increase in average income.

The results for the equation explaining the percentage in private schools generally support the theory, especially when it is estimated for secular enrollment. When the variation of income is included in the regression its coefficient is positive and statistically significant, while median income is insignificant. Limits on the rate of revenue increases result in greater private school enrollments. However, tax rate limits lower private enrollments, contrary to the theory's prediction.

The equation explaining the number of districts is new in the literature. The only other empirical work was ancilliary and relied solely on state dummy variables. The results of the equation presented here provide evidence of the tradeoff between the lower costs of large districts that exploit economies of scale and the desire for homogeneity, which leads to small high cost districts.

CHAPTER 1
INTRODUCTION

In 1980, 10.9 percent of school age children were enrolled in private school in the United States. There were great variations by both region and state. The state with the highest proportion in private school, Delaware, registered 19.5 percent; the lowest, Idaho, had 2.68 percent. The Northeast region had 15.2 percent, while in the South 8.0 percent were enrolled in private school.[1] There are a number of reasons why it is important to understand the causes of these variations.

First of all, federal and state governments direct many policies at the public schools, which they feel are necessary for a fair society. Examples of these policies are desegregation of the public schools and equalization of per pupil expenditures among school districts within a state. These policies can be circumvented and the goals unfulfilled if enough families exercise their option to leave the public school system. Clotfelter (1976) examined white flight into private schools as a result of desegregation policy and found that in districts where desegregation would have meant a black majority in the schools, whites exited *en masse*. White flight into private schools made desegregation of those schools impossible.

In the early 1970s many states began to implement equalization policies regarding public school financing. Generally, these policies were aimed at equalizing expenditures per pupil across the state. No one has investigated whether wealthy residents have left the public schools as a result of these equalization policies, which may result in binding limits on public school spending.

States have attempted to achieve equalization primarily through two different policies. The first puts limits either on property tax rates levied to fund education or on the rate of revenue increases from one year to the next. By constraining local tax rates and revenues, local funding for public schooling is also constrained. In high tax districts the tax rate will be forced down which will reduce spending per pupil. This type of policy equalizes expenditures by limiting districts that fall in the upper tail of the tax rate or revenue distribution. It is shown in Chapter 2 that this policy results in a greater fraction of families sending their children to private school.

The second method of equalizing expenditures per pupil is to reduce the local government's role of raising revenue for education by increasing nonmatching state aid. This type of policy equalizes from below; by setting a minimum foundation level of state support, the average quality of education in all districts rises. This policy's results are also discussed in Chapter 2, where it is shown that lump sum subsidies will not affect enrollments unless there are

strings, such as a minimum tax effort, attached to the aid. If strings are present, the percentage of students enrolled in private school will decrease.[2]

Other seemingly innocuous public policies may also cause households to choose private schools for their children. For example, some states require county and school district boundaries to coincide. There will be less diversity in school quality in a state with this policy than in a state with subcounty districts. Unable to find a school district with a satisfactory level of educational quality, a greater fraction of households will opt for private school in the constrained state. It is important to know if such laws indirectly weaken public education.

Finally, by looking at the demand for private schools we can tell how well public schools are satisfying households' demand for education. In the U.S., if families cannot find the quality of education that they desire publicly in the area where they live, they can move to a different area or send their children to a private school. A high percentage of students enrolled in private schools indicates the presence of high costs or small benefits of moving to another district and points to dissatisfaction with the public schools in that district. Understanding the causes of this dissatisfaction is important to those who care about public schools.

The private school enrollment literature has primarily focused on two aspects of the public/private school choice.[3]

The first set is interested in the effect of public school quality on private enrollments. It includes papers by Gustman and Pidot (1973), Sonstelie (1979), and West and Palsson (1988). In the first two papers the quality of public school is measured by expenditures per pupil. Both find a significantly negative relationship between expenditures and private school enrollment.[4] West and Palsson find that private school enrollment is negatively correlated with their measure of school quality, the teacher/pupil ratio. It is remarkable that all find this relationship given that their data differ so much. Sonstelie uses 333 census tracts that belong to 36 unified districts in Los Angeles. West and Palsson use state level data, and Gustman and Pidot use data for 79 urban areas. All make a reference to the median voter choosing the quality levels of the schools, yet none use data from the level of government where the decision is being made, namely the school district. In this paper, the theoretical model describes decisions of the median voter and other families in the school district. The empirical estimation is performed using school district data.

The second set of papers investigates the role of demand differentiation on private school enrollments. Some members of the community desire a higher quality level or ethnically different type of schooling than is available in the public schools, so they exit to private schools. It is

this literature that is particularly relevant to this thesis.

Bendrick (1977) estimates three enrollment equations with state level data. The dependent variables are the shares in public school, in secular private school, and religious private school. The variables that are proxies for demand differentiation are residual income, residual education, the percentage black, and the percentage Catholic. Residual income is calculated using income cells above median income. The number of people in each cell is multiplied by the mean income level for the cell. Each cell's products are added together and then divided by the sum of the products for all income cells. Residual education is constructed that same way. Residual income was insignificant in each of the three regressions, while residual education positively affected both types of private school enrollment as predicted. The percentage black increased private enrollments. The percentage Catholic increased religious enrollments.

James (1987) discusses demand differentiation as a motivation for sending one's children to private school in developed countries. Again, using state level data, she estimates separate equations for elementary and secondary enrollment. Only including variables that measure ethnic heterogeneity, she also finds that the percentages of Catholics and blacks affect private enrollment. She does not attempt to include a measure of income heterogeneity in

her analysis. The only measure of income used is per capita income, which has a positive effect on enrollments.

Martinez-Vazquez and Seaman (1985) develop a model to explain private school enrollment in Standard Metropolitan Statistical Areas (SMSAs). Families will send their children to private schools if their utility from doing so is greater than it could be in any school district in the SMSA, taking into account moving costs. Since education is a normal good, those with higher income in the SMSA are more likely to be better off with children in private school. Income driven demand differentiation is proxied by the variable percentage with incomes over $25,000. The demand differentiation motive is mitigated to the degree that there is more choice among districts within SMSAs. They include the number of unified (K-12) districts in the SMSA, the number of schools in districts with twenty or more schools, and the interaction of these two, as measures of the degree of choice among public schools. The model is estimated with SMSA level data. Their results generally support their hypotheses. They interpret the results as a successful test of the Tiebout hypothesis. This interpretation draws from the work of Hamilton, Mills, and Puryear (1975) and Eberts and Gronberg (1981).

Briefly, Tiebout's (1956) hypothesis says that local public goods are efficiently provided by small communities made up of homogeneous individuals. People will sort themselves into these communities by "voting with their

feet" based on their desires for a bundle of locally provided public goods, or, in the case of education, locally and publicly provided private goods. In a perfectly Tiebout world there are as many communities as preferences, so each community is totally homogeneous. There is no demand for private schools. Each household is consuming its preferred level of education publicly. The world in which we live is not perfectly Tiebout, however. There are economies of scale in the production of education. Large schools and school districts take advantage of these economies. For this reason number of school districts is smaller than the many different preferences of households regarding school quality. As a result, school districts are not perfectly homogeneous. A direct consequence of the Tiebout model is that the proportion of students attending private school will be larger in a school district that is more heterogeneous.

There have been numerous tests of the Tiebout hypothesis. Several studies have looked at capitalization of net public benefits into housing values, this work began with Oates (1969). Hamilton et al. and Eberts and Gronberg tested the Tiebout using a different approach. They estimated equations that explained the variation of within jurisdiction income heterogeneity with variables that affect the costs and benefits of sorting among jurisdictions. In other words, they were interested in determining whether the SMSA actually does exhibit the characteristics of a

marketplace for public goods. Both studies found that it does.[5] One important result for Eberts and Gronberg and Hamilton et al. was that the more choice with respect to the local public good among jurisdictions within the SMSA, the lower the income heterogeneity in the SMSAs' school districts and census tracts, respectively. The degree of choice was proxied by the number of districts in the SMSA. Martinez-Vazquez and Seaman used these results to formulate their model and interpret their results.

This dissertation makes significant contributions to the private school literature in a number of ways. First, a theoretical model is presented that extends Lovell's (1975) model by allowing for private school enrollment. Using Downs' (1957) median voter model and Cobb-Douglas utility, a prediction is generated that is consistent with the Tiebout hypothesis, namely, that the variation in income, rather than the average level of income in the school district, affects private school enrollment. This result is in conflict with the empirical literature that almost entirely relies on per capita or median income. Even the $25,000 and over variable, interpreted as a measure of income differentiation by Martinez-Vazquez and Seaman, actually measures the level of income across SMSAs.

Secondly, as mentioned earlier, this model is relevant to the school district, where choices are made. The average school district in the SMSA is the unit of measurement in the empirical chapter. The sample consists of 134 average

districts. The SMSA is viewed as the marketplace for education. Characteristics of the SMSA will affect the ability of families to sort themselves into homogeneous districts. These characteristics and their effect on sorting are explicitly modeled in a four equation system.

Finally, the impact of public school expenditure equalization policies on private school enrollment is examined both theoretically and empirically. Inman (1978a) used simulation to analyze the effect of a number of proposals on New York school districts, but there has not been any work done to determine what effects these policies have actually had on private school enrollment.

Equalization programs may also reduce the benefits of sorting, thereby increasing the degree of income heterogeneity in an SMSA's districts. Hamilton et al. described state aid as breaking the link between tax liability and consumption of the public good. They found, as did Eberts and Gronberg (1981), that state aid increases income heterogeneity. As a method of equalizing expenditures across districts, it will also reduce the degree of choice among public alternatives, again, increasing heterogeneity within districts.

One of the equations in the four equation model explains the degree of income heterogeneity. It is defined as the fraction of families with incomes 100 percent above median income and explained by many of the same variables used in previous studies. Two additional variables are

included in the equation to determine the effect of tax and revenue limitations on the incentive to sort. These policies were introduced after 1970, the period from which other studies' data come. They are expected to have a similar effect on the sorting mechanism as state aid.

As an aside, Eberts and Gronberg discuss the endogeneity of the number of jurisdictions (in this case school districts). To eliminate endogeneity bias they use the method of instrumental variables. The instruments consist solely of eight state dummy variables. I account for this endogeneity, as well. The number of school districts in a SMSA is explained by variables that affect two competing forces--economies of scale and desire for homogeneous jurisdictions. The presence of economies of scale means lower costs for larger districts and will lead to a few heterogeneous jurisdictions. On the other hand, the desire for homogeneous jurisdictions will dictate small, high cost districts. This conflict was first noted by Rothenberg (1970) in the context of Buchanan's (1965) theory of clubs.[6] This is the first empirical model that attempts to explain the number of jurisdictions in these terms.

The structure of this thesis is as follows. A theoretical model is presented in Chapter 2 that addresses the median voter's choice of public school quality and the public/private school choice of other families in the district. The four equation empirical model and the data sources are introduced in Chapter 3. The results of the two

stage least squares estimation of the model are discussed in Chapter 4. Chapter 5 contains the summary and conclusions.

1.1 End Notes

1. These are figures from Gemello and Osman (1984).

2. Details of various types of equalization policies are given in Grubb (1974) and Michelson (1974).

3. It is these two groups of articles, which focus on the effects of public school quality and demand differentiation, with which this thesis is most concerned. There have been other empirical studies that attempt to explain private school enrollment. These include Gemello and Osman (1984), Long and Toma (1988), and Ereckson (1982).

4. There have been other papers that include this variable, although that is not the focus of their work. In two of these articles, Ereckson (1982) and James (1987), the coefficient on expenditures per pupil was positive.

5. Pack and Pack also looked at intrametropolitan income variation. They determined the within community variance of income for 13 SMSAs in Pennsylvania was larger than could be accounted for by transitory effects. They tested a strict version of Tiebout--that there is no income variation within communities. Eberts and Gronberg and Hamilton et al. tested whether there was evidence of sorting. They also accounted for differences in SMSAs regarding the ease of stratifying by income.

6. For additional sources on the theoretical question of the optimal number of jurisdiction in the club context see Sandler and Tschirhart (1980). Tiebout assumed this conflict away. In his model all communities were operating at minimum average cost.

CHAPTER 2
THE THEORETICAL DETERMINANTS OF PRIVATE SCHOOL ENROLLMENT

The following theoretical model identifies the median voter,[1] the determinants of the median voter's choice of public school educational quality, and explains the fraction of students in a district who are enrolled in private school. Using Lovell's (1975) Cobb-Douglas utility framework, we first look at the decisive voter's choice of educational quality in the absence of a private alternative. Then, extending Lovell's analysis, the presence of private schools is taken into consideration.

Within the context of this model, it is shown that there exists some break-even level of income, above which all families send their children to private school. It is further shown that the fraction of families above break-even income is affected only by the variance and skewness of the income distribution, not by mean and median income in the school district. These results are important in view of the existing empirical literature that investigates private school enrollment. In these studies, either mean or median income is used to explain the percentage of students enrolled in private school. The results presented here indicate that this is the incorrect income variable. Instead, a measure of income heterogeneity should be used as an explanatory variable in empirical work done on this topic.

2.1 The Median Voter's Choice of Public School Quality in the Absence of Private Schools

All households in the school district have the Cobb-Douglas utility function:

$$U = a\ln C + (1-a)\ln E, \tag{1}$$

where

E = the quality of primary and secondary education per pupil, and

C = the consumption of all other goods.

Each family's income is spent in educational services and all other goods. Educational services are financed by a tax on income.[2] Its budget constraint is

$$Y_i = C + tY_i, \tag{2}$$

where

t = the local tax rate facing the household,

Y_i = family income, and

price of C = 1.

Since each school district must balance its budget,

$$npE = t\bar{Y}, \tag{3}$$

where

p = the price of E in terms of C,

$\bar{Y}$ = average household income, and

n = average number of children per family.

Solving (3) for t and substituting into (2) results in

$$Y_i = C + np(Y_i/\bar{Y})E \tag{4}$$

Without private schools the median voter is the voter with median income.[3] The median voter, denoted by subscript m, maximizes utility (1) subject to the budget constraint (5),

(5) $$Y_m = C + np(Y_m/\bar{Y})E$$

If education could be purchased privately, its price would be np for all families. The tax price of public education is $np(Y_m/\bar{Y})$ for the median family, however. Because education is publicly provided, the price of educational quality is lower to the median family than it would be if it could only purchase education privately, given that the income distribution is skewed to the right. This result was first derived by Lovell (1975) and holds regardless of the utility function that is specified.

Forming the Lagrangian from (1) and (5),

(6) $$L = a\ln C + (1-a)\ln E + \tau[Y_m - C - np(Y_m/\bar{Y})E)]$$

where

τ = the Lagrange multiplier

The first order conditions for this maximization problem are,

(7) $$\delta L/\delta C = a/C - \tau = 0$$

(8) $$\delta L/\delta E = (1-a)/E - \tau np(Y_m/\bar{Y}) = 0$$

(9) $$\delta L/\delta \tau = Y_m - C - \tau np(Y_m/\bar{Y})E = 0$$

Using the first order conditions we can solve for the decisive voter's choices of educational quality per pupil and private consumption

(10) $$E^* = \frac{(1-a)\bar{Y}}{np}$$

(11) $$C^* = aY_m$$

When utility is Cobb-Douglas and there are no private schools, the choice of public education depends on the price

of education in terms of other goods, average family income, and the number of children per family. Greater average family income leads to more education being provided through the public school system. More children per family leads to lower expenditures per pupil, which is consistent with a quality-quantity tradeoff for children which has been noted elsewhere.[4]

2.2 The Median Voter's Choice of Public School Quality in the Presence of a Private School Alternative

Extending Lovell's analysis, now the children living in a school district need not attend the public schools. The decisive voter takes into account the fact that as some children are sent to private school, any given level of public school expenditure is spread over fewer children in the public schools.[5] This reduces the tax price of an additional unit of educational quality in public schools, because even though the number of children in public school has declined, the number of tax payers is the same as it would be if all children attended public school. Further, the decisive voter is no longer the voter with median income. Families that send their children to private school now desire little spending on public education. They will form a coalition with low income voters. The result will be a median voter with less than median income.[6]

The Lagrangian for the median voter is now

$$(12)\quad L = a\ln C + (1-a)\ln E + \tau(Y_m - C - np(Y_m/\bar{Y})(1-s)E)$$

where

E = quality of public education per public school pupil,

s = the fraction of students enrolled in private school.

The first order conditions are

(13) $$\delta L/\delta C = a/C - \tau = 0$$

(14) $$\delta L/\delta E = (1-a)/E - \tau np(Y_m/\bar{Y})(1-s) = 0$$

(15) $$\delta L/\delta \tau = Y_m - C - \tau np(Y_m/\bar{Y})(1-s)E = 0$$

We can solve for the decisive voter's choice of public education and consumption of all other goods,

(16) $$E_2^* = \frac{(1-a)\bar{Y}}{np(1-s)} = \frac{E^*}{(1-s)}$$

(17) $$C_2^* = aY_m$$

The quality of education in public school per child is E_2^*.

The quality of the public schools increases as the fraction of students attending private schools increases. There are two effects introduced when private schools are allowed for. First, with fewer students in public school the cost of raising quality by one unit falls, leading to higher quality per student. Secondly, the decisive voter has changed. The median voter in the voting distribution now has less than median income. However, equation (16), like equation (10) does not depend on the decisive voter's income. This result is consistent with Lovell (1975) and Kenny (1978), who both showed that there is unanimity at the voting booth regarding the provision of a collective good, when preferences are Cobb-Douglas.[7] With Cobb-Douglas utility, the presence of private schools changes the

provision of public education only because the tax price of public education to the median voter is lower than otherwise, not because the identity of the median voter has changed.

2.3 The Public/Private Schooling Decision

After the median voter makes his choice, all other families in the school district must decide whether to accept E_2^* or send their children to private school.[8] Of course, as they make their decision, s changes, which in turn changes the quality of education per public school student. The equilibrium values, E_2^* and s^*, are determined simultaneously.

Figure 2.1 is a graphical depiction of the budget constraint of a relatively wealthy family. Whether or not a household sends its children to private school, it must pay taxes to finance public schools. If this family decides to send its children to public school, it will be able to consume $Y_w(1-(pn(1-s)E_2^*/\bar{Y}) = C'$ units of C, where $pn(1-s)E_2^*/\bar{Y}$ is the tax rate chosen by the median voter and Y_w is the wealthy family's income. If it sends its children to a private school that has the same quality as the public schools, it will only be able to consume $Y_w(1-(pn(1-s)E_2^*/\bar{Y})) - pnE_2^* = C''$ units of C, assuming that public and private producers of education are equally efficient and face the same input prices. The cost of one unit of private school quality to any family, regardless of income, is pn. It is also the slope of line segment AB. The quality level of

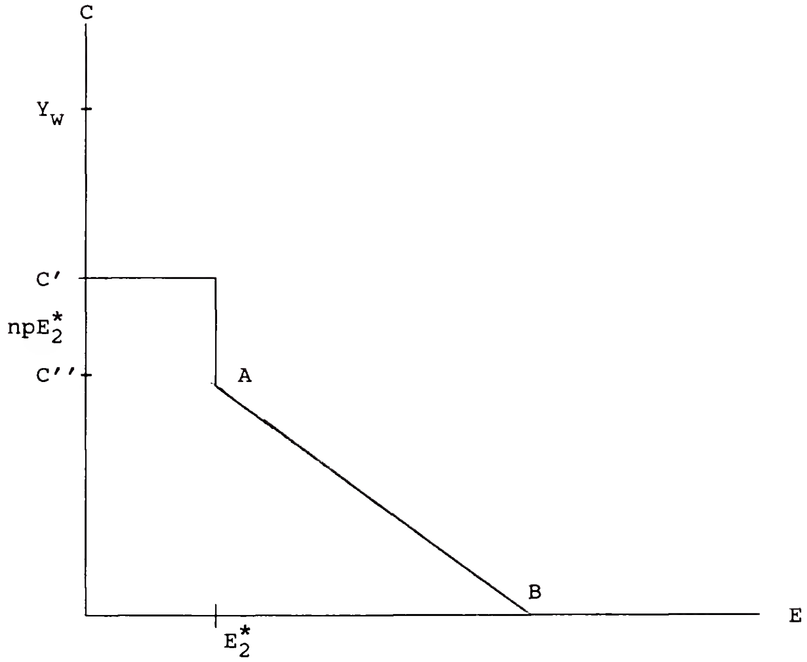

Figure 2.1
The Budget Constraint of a Wealthy Resident

public school in the district is E_2^*. The fixed cost of sending children to private school is represented by pnE_2^*. This cost will be higher in districts with superior public schools. The kink in the budget line is a result of this cost of replicating public school quality. At quality levels below E_2^* the household will choose public schools (it will not pay tuition to receive a lower quality level). A family will choose private schooling if its highest feasible indifference curve is tangent to the budget line along line segment AB.

The Lagrangian for a family with income Y_i in the school district, that sends its children to private school, is

(18a) $$L_i = a\ln C + (1-a)\ln E^{pr} + \tau[Y_i - np(Y_i/\bar{Y})(1-s)E_2^* - C - npE^{pr}]$$

Substituting for E_2^* using (16) and (10), the Lagrangian becomes

(18b) $$L_i = a\ln C + (1-a)\ln E_{pr} + \tau(aY_i - C - npE_{pr}),$$

where aY_i is the amount of income the ith family has remaining after paying the tax for public school education.

Assuming an interior solution, the first order conditions are

(19) $$\delta L_i/\delta C = a/C - \tau = 0$$

(20) $$\delta L_i/\delta E_{pr} = (1-a)/E_{pr} - \tau np = 0$$

(21) $$\delta L_i/\delta \tau = aY_i - C - npE_{pr} = 0$$

Solving for the family's choice of private educational

quality and consumption of other goods, E_{pr} and C_{pr},

(22) $$E^{pr} = (1-a)aY_i/np$$

(23) $$C^{pr} = a^2Y_i$$

Private school quality consumed and consumption of all other goods by families who choose private school are independent of s. Private school quality demanded depends positively on the family's income and negatively on the number of children in the family and on the price of private schooling.

Holding the price of private schooling constant, there will be some level of income at which the family is indifferent about sending its children to public or private school. To find this level of income, Y_b, the utility of a family who sends its children to public school, $U(C_2^*,E_2^*)$, where $C_2^* = aY_i$, is set equal to the utility of a family who sends its children to private school, $U(C_{pr},E_{pr})$, and income is solved for

(24a) $$U(C_2^*,E_2^*) = U(C_{pr},E_{pr})$$

(24b) $$(aY)^a[(1-a)\bar{Y}/(np(1-s))]^{1-a} = (a^2Y)^a[a(1-a)Y/np]^{1-a}$$

(24c) $$a^aY^a[(1-a)\bar{Y}/(np(1-s))]^{1-a} = a^{2a}Y^aY^{1-a}[a(1-a)/np]^{1-a}$$

(24d) $$aY^{1-a} = [\bar{Y}/(1-s)]^{1-a}$$

(24e) $$Y_b = \frac{a^{1/(a-1)}\bar{Y}}{(1-s)}$$

A number of characteristics of the school district's break-even income are revealed by equation (24e). First, it will always be greater than mean income and will be greater than median income so long as the income distribution is skewed to the right. Secondly, as the share of income spent

on education rises break-even income rises. A higher share of income spent on education means higher quality public schools. This raises the fixed cost of private education. Only families that desire a much higher quality of education will opt for private schools. Since education is a normal good, these families must have a much higher income when 'a' is larger. Finally, as the number of students in private school increases break-even income rises. A rise in private school enrollments will also increase public school quality and the fixed cost of attending private school.

<u>Proposition 1</u>: Y_b is the break-even income such that all families with income above Y_b will send their children to private school and all families with income below Y_b will send their children to public school.

<u>Proof</u>: Take the first and second derivatives of the utility functions on both sides of (24b):

(25a) $$\frac{dU^*}{dY} = a^{1+a}Y^{a-1}[(1-a)\bar{Y}/(np(1-s))]^{1-a} > 0$$

(25b) $$\frac{d^2U^*}{dY^2} = (a-1)a^{1+a}Y^{a-2}[(1-a)\bar{Y}/np(1-s)]^{1-a} < 0$$

(26a) $$\frac{dU_{pr}}{dY} = a^{2a}[a(1-a)/np]^{a-1} > 0$$

(26b) $$\frac{d^2U_{pr}}{dY^2} = 0$$

From (24) we know there is a point of intersection of the two utility functions at positive income level Y_b and at Y

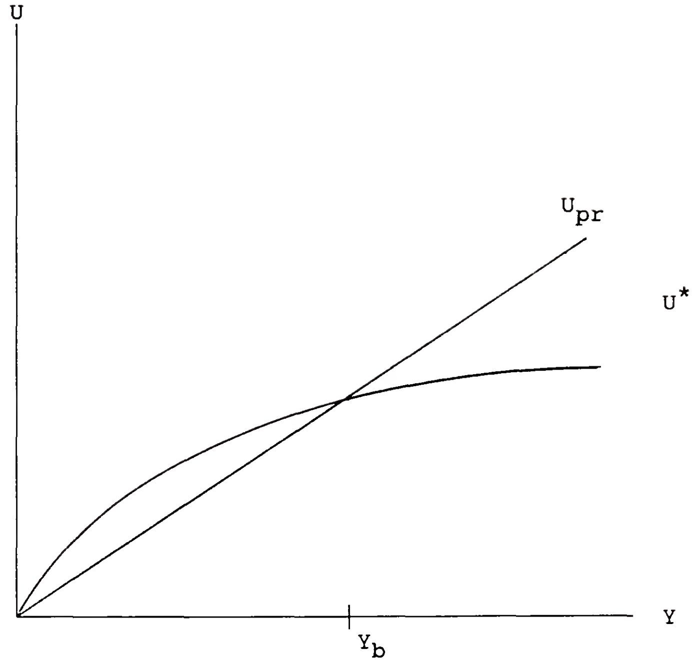

Figure 2.2
Depiction of the Proof of Proposition 1

equal to zero. Since the utility function under the public school alternative is concave and the utility function under private schooling is linear, it must be the case that all families that have incomes above Y_b will send their children to private school. (See Figure 2.2.) QED.

2.4 The Role of Income Dispersion within a School District

Because Y_b is the level of income that makes families indifferent between public and private schooling, s can be defined as the percentage of families with incomes above Y_b

$$s = 1 - F(Y_b) \tag{27}$$

where F( ) is the cumulative density of the income distribution in the district. The values of s^* and Y_b are determined by solving (24e) and (27) simultaneously. This may be impossible to do analytically, but the result can be shown graphically (Figure 2.3).

In Figure 2.3, the equation defining Z(Y) is (24e) solved for s

$$s = 1 - \frac{a^{1/(a-1)}\bar{Y}}{Y_b} = Z(Y) \tag{24f}$$

This function has a positive first derivative and negative second derivative, with respect to income. Its intercept on the income axis is above mean income, as discussed in section 2.3.

The second function in the figure is equation (27), for all values of Y. The intersection of these two functions determines s^* and Y_b.

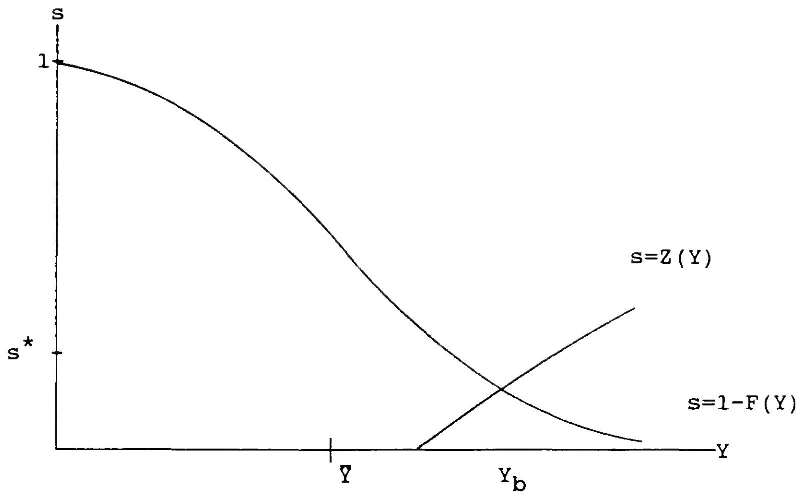

Figure 2.3
Simultaneous Determination of s^* and Y_b

It was noted earlier that previous studies of private school enrollment have relied on mean or median income as a primary determinant. It has already been shown that the percentage of children enrolled in private school depends on the number of families above the break-even level of income, which itself is a function of average income in the district. It can further be shown, using this framework, that a change in average income in a school district does not affect the equilibrium value of s. That is, if all incomes increase by some constant percent in a school district, so that $\bar{Y}$ increases by that percentage, s* for that district will stay the same. Only the skewness and variance of the distribution and the share of income spent on education will affect private school enrollment.

Proposition 2: If two public school districts have identical income distributions, except that one is a multiple, k, of the other, both will have the same percentage of students in public school.

Proof: Mean income in the first school district is $\bar{Y}$. Mean income in the wealthier second district is $k\bar{Y}$, where $k > 1$. $F_1(Y)$ is the cumulative density function of income in the first district. $F_2(Y)$ is the cumulative density function of income in the second district.

(28) $$s = 1 - F_1(Y) = 1 - F_2(kY)$$

The fraction of families with incomes above some Y in the

first school district is the same as the percentage above kY in the second school district.

(29) $s=Z_1(Y) = 1 - a^{1/a-1}\bar{Y}_1/Y = 1 - a^{1/a-1}k\bar{Y}_1/kY = Z_2(kY)$

Following (28) and the definition for Z( ) above, at kY_b, where Y_b is the equilibrium break-even level of income in district 1,

(30) $$Z_1(Y_b) = Z_2(kY_b)$$

and

(31) $$1 - F_1(Y_b) = 1 - F_2(kY_b)$$

Therefore, a school district with k percent higher mean income than another school district will have the same fraction of students enrolled in private school given that the other moments of the distribution and preferences (i.e. 'a') are the identical.

QED.

The proof is depicted graphically in Figure 2.4.

<u>Conjecture 1</u>: If two school districts have the same mean income, but the first school district has median income Y_{m1}, which is greater than Y_{m2}, median income in the second district, then the second school district will have a greater percentage of students enrolled in private school.

<u>Discussion</u>: Since mean income and the share of income spent on public education are the same, Z(Y) is the same for both school districts.

For the conjecture to hold three conditions must be satisfied. First, the second derivitive of the cumulative

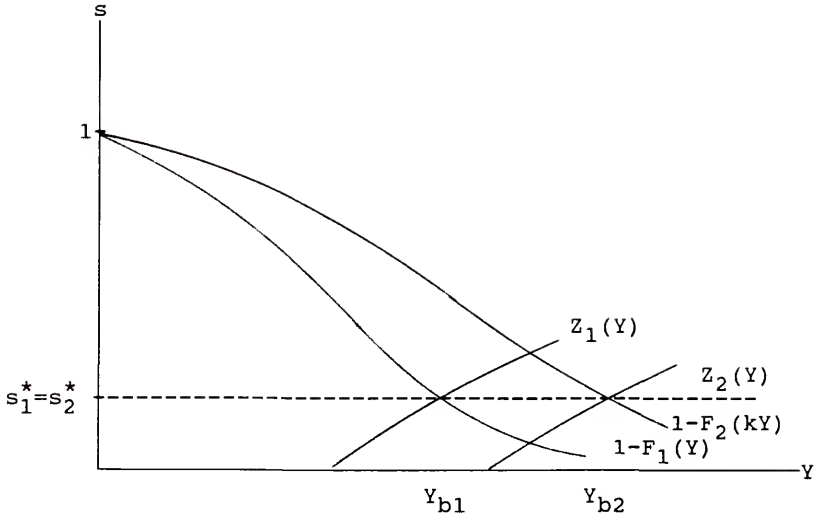

Figure 2.4
Depiction of the Proof of Proposition 2

income distribution may not be zero throughout. Second, the income distributions must be single peaked. These conditions guarantee that the two distributions will intersect only once, at a positive level of income. Finally, the two distributions must intersect before reaching Z(Y). The necessity of these conditions can be seen in Figure 2.5, where the conjecture is illustrated.

Proposition 3: If two school districts have equal mean and median incomes, but the first has a larger variance than the second, the first will have a larger percentage enrolled in private school, assuming the normal distribution.

Proof: Again, Z(Y) is the same for both school districts, since mean income and the fraction of income spent on education are the same.

Let F(Y) be the cumulative normal distribution for the district with the smaller variance and let G(Y) be the second district's cumulative normal distribution. Let W represent the distance of Y from μ_Y, standardized by σ. W=N(0,1). For all values of Y above μ_Y, W will be larger for the district with the smaller variance of income. So,

$$1-F(Y_o) < 1-G(Y_o) \tag{32}$$

Since Z(Y) has a positive first derivative, the district with the larger variance has higher values of s^* and Y_b. QED.

See Figure 2.6 for a graphical depiction of the proof.

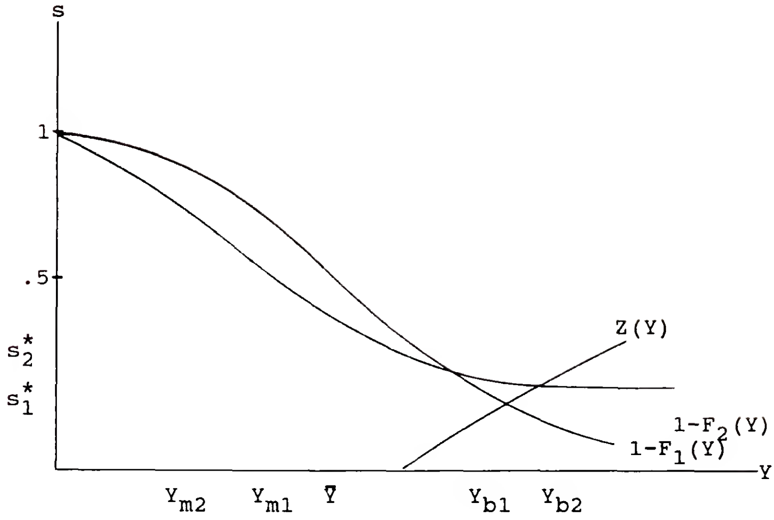

Figure 2.5
Depiction of Conjecture 1

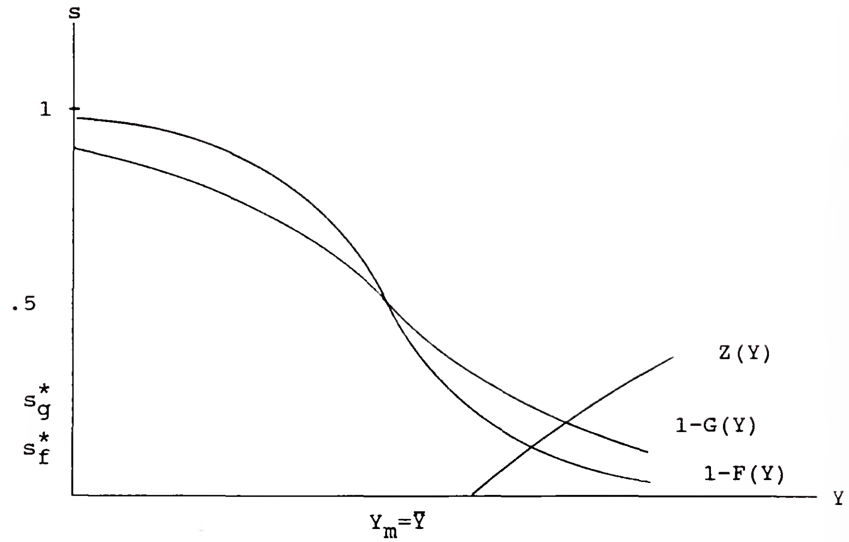

Figure 2.6
Depiction of the Proof of Proposition 3

Propositions 2 and 3 and conjecture 1 correspond nicely with the Tiebout Hypothesis. Tiebout described a world where individuals sort themselves into communities based on their preferences for local public goods bundles. In theory, there would be an infinite number of perfectly homogeneous communities. The provision of local public goods would be efficient. A logical extension of Tiebout's theory is that the more homogenous a community is with respect to public good preferences, the more satisfaction within the community with respect to public good provision. What propositions 3 and 4 imply is that the more heterogeneous a school district is with respect to income the more families will be sufficiently dissatisfied with the public schools to send their children to private school. Proposition 2 means that wealthy districts are no more or less likely to have a high percentage of children in private school than poor districts, unless these districts are more likely to be skewed or have large variances of income. These results indicate that income heterogeneity should be of primary interest in empirical studies that attempt to explain variations in private school enrollment.

2.5 Public School Expenditure Equalization Policies

The effect of different expenditure equalization policies on private school enrollment can be analyzed by returning to the budget constraint that was introduced in section 2.3.

The impact of a binding tax limitation policy is depicted by Figure 2.7. The single lined budget constraint faces a wealthy family when there is no limitation. In the absence of a limitation on tax rates, this particular family is indifferent between public and private education. After the limit goes into effect, the family faces the double lined constraint. The new constraint is higher than the old because the maximum tax rate that can be chosen by the median voter is lower than in the no limit case. In the presence of the limit he cannot choose a public education quality above $\bar{E}$. The new tangency indicates that after the limit is imposed this wealthy family will choose to send its children to private school. From this example it can be inferred that the level of income that results in indifference between the two systems has fallen. In fact, it is possible that even the median voter of the school district will opt for the private alternative. A greater fraction of families in this school district will now send their children to private school. A binding limitation on the rate of revenue increase will produce the same result.

Increasing lump sum state aid in the school district, the second type of equalization policy, will not affect private school enrollment unless there are requirements, such as a minimum tax effort, associated with the aid. If there are no such restrictions, the aid simply has the same effect as an increase in average income. Using the results from Section 2.4, namely Proposition 2.2, we can conclude

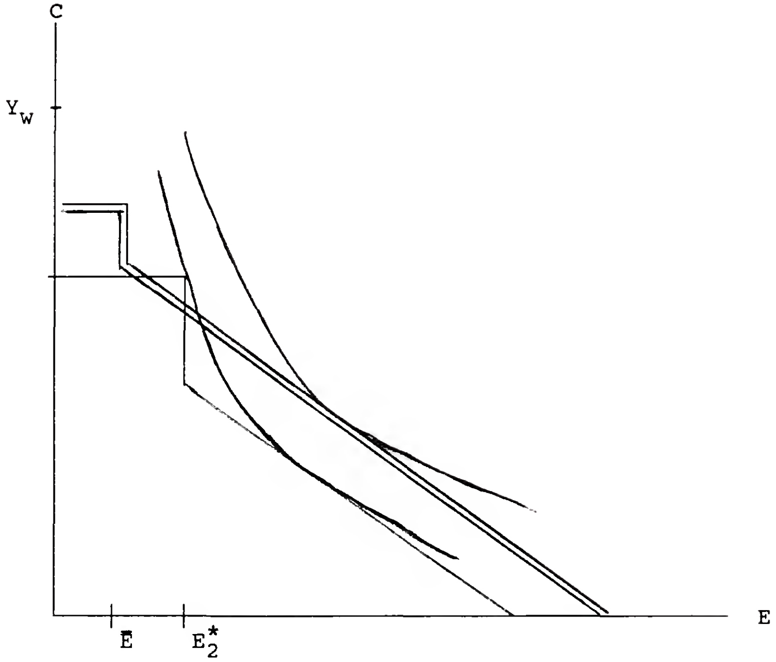

Figure 2.7
The Effect of Tax and/or Revenue Limits

that, in this case, state aid will not affect private school enrollments.

If conditions associated with lump sum aid are binding on a district, more education will be provided publicly than is desired by the district. This higher quality level will cost more to duplicate in the private schools. Private school enrollments will fall.

2.6 <u>Conclusions</u>

The analysis in this chapter differs considerably from the theory used in other papers explaining private school enrollment. In Sonstelie (1979) and Martinez-Vazquez and Seaman (1985), for example, utility maximization is also the framework employed, but there is no discussion regarding who determines the public education level in the school district or the importance of the relationship between the decisive voter and the other members of the district. The individual family is looked at in isolation. The outcome of these models suggests that the level of income in a school district, or SMSA is what matters when explaining private school enrollment percentages. Here, the shape of the income distribution, rather than the mean or median alone, is a determining factor of private school enrollment in a school district. In addition, the analysis has been extended to examine the impact of public school equalization policies. These policies affect private school enrollment by altering the decisive voter's choice of educational

quality, which in turn changes the fixed cost of private school.

2.7 End Notes

1. The median voter, in this chapter, refers to the median family in the voting distribution. Often, the median voter identified as the family with median income (see note 2). Here, the median voter may or may not have median income.

2. Property taxes are the most commonly used method used to raise revenues for public education. A proportional tax on income is a reasonable approximation to a property tax, given the strong correlation between property wealth and income and the single tax rate used in districts.

3. This assumes that a family's position in the voting distribution with respect to public school expenditure corresponds to its place in the income distribution. There has been a good deal of research on this question. For evidence supporting the median voter hypothesis as it relates to educational expenditures see Inman (1978a) and Gramlich and Rubinfeld (1982).

4. See DeTray (1973), for example.

5. The decisive voter chooses E with the expectation the s remains constant.

6. Barzel (1973), Stiglitz (1974) and Brown and Saks (1983) describe this coalition and its effects. Stiglitz (1974) and Flowers (1975) discuss the possibility of double peaked preferences for families with children in private school. If the quality of the public school is almost high enough for the family to re-enter the public schools it may vote for higher expenditures as it did when the children were attending public school.

Abstracting away from the possibility of double peaked preferences, define s to be the fraction of families with children in private school. $s = 1 - F(Y_b)$, where F( ) is the cumulative density of the income distribtuion and Y_b is some break-even level of income above which all families send their children to private school (see section 2.3). Then the median voter (V_m) will have less than median income (Y_m). G( ) is the cumulative density of the voting distribution.

$$G(V_m) = F(Y_m) - [1-F(Y_b)] = .5$$

7. Kenny's (1978) more general result is that there is an increase in quality demanded for a collective good as you move up along the income distribution only if the income

elasticity for the collective good is greater than the elasticity of substitution between the collective good and other goods. In the case of Cobb-Douglas, these two are equal to each other.

8. Families have a third choice--they can move to another school district. This decision is not modeled here. In the empirical analysis, the income and racial heterogeneity of a school district are used as a measure of the ease of moving from one district to another.

CHAPTER 3
EMPIRICAL DETERMINANTS OF PRIVATE SCHOOL ENROLLMENT

A four equation system will be presented in this chapter. Together, these equations model the relationship between characteristics of SMSAs and their districts and the public/private school choice. The dependent variables are: the logistic functional form of the percentage of children enrolled in private school, the log of expenditures per pupil in the public schools, the logistic form of a variable measuring income heterogeneity, and the number of school districts in the SMSA.

The unit of observation is the average school district in the SMSA. This may come as a surprise, since the unit used in the theoretical analysis was the school district, itself. One may wonder why all United States school districts, or a subset of them, do not constitute the sample. The reason is that the empirical model seeks to utilize the Tiebout hypothesis as a basis for explaining private school enrollment. Since employment acts as a constraint on the area of residence, a geographical area is needed within which families select a school district for their children. It is unlikely, for example, that a family whose members work in Baltimore, Maryland, will consider school districts in Philadelphia, Pennsylvania. To that end, the SMSA is pictured as a market for public education. Families can 'shop' for a district within the SMSA. At the

same time, by using the average district, the analysis in Chapter 2 can be applied because we are looking at a single, if nonexistent, school district in each SMSA.

The private school equation is estimated twice in Chapter 4. The logistic form of the percentages enrolled in secular and religious private schools for grades kindergarten through twelve are each used as the dependent variables. The theory that is being tested does not explicitly treat religious preferences. In the United States, religious instruction is not allowed in the public schools no matter how homogeneous the school district with respect to religious preference. For this reason the theory is expected to be more strongly supported by the equation with percentage enrolled in secular private school as the dependent variable. For this sample of 134 SMSAs, eighty-four percent of private school students are in religious schools.

The instrumental variables technique is used to estimate three of the four equations. Ordinary Least Squares (OLS) is used to estimate the number of school districts equation. The instruments are all of the exogenous variables in the system.[1]

Table 3.1 gives the means and standard deviations for the variables that enter the model. The data sources include the 1980 Census of Population and Housing summary tapes by school district and the Survey of School District

TABLE 3.1
Desriptive Statistics

Variable	Mean	Standard Deviation
PRIV12	.1060	.0540
SEC12	.0160	.0140
REL12	.0890	.0500
|WC-BC|	.1540	.0670
OVERMED	.1051	.0220
HERRACE	.7621	.1496
AID	929.774	202.020
REVINC	.0051	.0277
TL	.0337	.1288
AVGKIDS	.8965	.1339
EXPEND	1867.461	343.662
PCATH	.1813	.1499
MEDY	19370.065	2501.748
SKEW	.8708	.0358
OOCC	.6672	.0695
AVGED	11.319	.7181
CRIME81	8331.029	2486.674
PH65	.1156	.0377
AVGAREA	316.342	408.305
STATESH	.4540	.0991
PCHANGE	.1914	.0844
HERSMSA	.7454	.1596
JURIS	24.729	37.4639
POP	701056.912	1299804.346
VARSMSA	404362435.216	93141245.977
COUNTY	.1753	.3820
PURBAN	.794	.126
JULY	77.26	5.489
JAN	38.46	12.907

Finances, 1979-1980. The sources and sample selection methods are discussed in Section 3.5.

Below, the four equations and their variables are introduced. For reference throughout this and subsequent chapters, the definitions and sources of the variables are listed in Appendix A.

3.1 The Private School Enrollment Equation

The equation explaining the variation among SMSAs' private school enrollment is of primary interest in this chapter. The formulation of this equation is based on the theory presented in Chapter 2. It is an attempt to move away from the ad hoc approaches described in Chapter 1.

$$\begin{aligned} LPRIV = {} & a_0 + a_1 OVERMEDP + a_2 |WC\text{-}BC| + a_3 HERRACE + \\ & a_4 EXPENDP + a_5 AVGKIDS + a_6 REVINC + a_7 TL + a_8 AID + \\ & a_9 PCATH + u_1 \end{aligned}$$

It was shown in Chapter 2 that a school district's income dispersion in the upper end of the income distribution affects private school enrollment. The greater the degree of income heterogeneity, the more households will be above the threshold level of income that makes them indifferent between public and private schools.[2] OVERMEDP is the predicted value of the variable used to measure income dispersion. OVERMED is the average upper tail dispersion in the SMSA's districts. First, the fraction of families with incomes at least one hundred percent above median family income was calculated at the school district level for each SMSA in the sample. Then the values for each

SMSA's districts were averaged up to the SMSA level.[3] There are certainly better known income inequality measures. A number of these are discussed in Bourguignon (1979). OVERMED was chosen over other measures because only the upper end of the distribution is of interest here.

Forty different OVERMED variables were constructed. The measures differed by five percentage point increments above median income. One hundred percent above median was selected because it performed the best with respect to the maximum R^2 criterion. It was also closest to the percentage enrolled in private school. This finding, that the OVERMED variable that works best is also the one with nearly the same fraction of families as children enrolled in private school, supports the theory that stated that the percentage in private school is identical to the percentage above threshold income (see Section 2.3). Twice median income is an approximation to the threshold level. The expected sign of OVERMED's coefficient is positive. The magnitude is expected to be greater in the secular private school equation.

Two control variables measure other types of heterogeneity. These variables are included because income may not be the only factor that affects sorting within SMSAs. The presence of other racial and cultural groups and occupational classes may also result in dissatisfaction with public schools. $|WC-BC|$ is the absolute value of the

difference between the fraction of blue and the fraction of white collar workers. It takes on a maximum value of one if all districts in the SMSA are completely homogeneous with respect to this broad occupation measure. It will take a minimum value of zero if each district is evenly divided between white and blue collar workers. HERRACE is the sum of squared shares of four racial and ethnic groups (blacks, whites, hispanics and asians) in each district, averaged across districts. Its maximum value is one if each district is occupied by only one race; its minimum value of .25 occurs if the races are evenly dispersed in each district. The expected sign for both coefficients on HERRACE and |WC-BC| is negative. As districts become more heterogeneous, private school enrollment will increase.

The next variable, EXPENDP, is the predicted value of the weighted average of instructional expenditures per pupil in the SMSA. It represents the fixed cost of sending a child to private school that is the same quality as the public school in the district.[4] The expected sign on the coefficient of EXPENDP is negative.

AVGKIDS is the average number of children per family. In the theoretical analysis, it was represented by 'n'. As the number of children per family increases, a smaller percentage of children will be enrolled in private school. This is due to the quality-quantity tradeoff parents must make. The burden of tuition for the average family is greater the larger the number of children.

REVINC and TL are variables measuring the extent of binding revenue increase and tax rate limits respectively. AID is state aid per pupil in the district averaged up to the SMSA. Together these variables represent the most common equalization policies used by the states. By writing to every state's Department of Revenue or Department of Taxation, it was determined which SMSAs were affected by which type of equalization policy, if any. However, it could not be determined from the information provided which school districts in the SMSA were bound by tax and revenue limits. REVINC and TL were constructed to approximate the percentage of districts in each SMSA that are constrained.

For SMSAs in states where the rate of revenue increase is limited by law, if the rate of population growth in an SMSA's county exceeded the rate of growth for the state as a whole by at least two standard deviations, the districts in that county were assumed to be constrained by the limit. REVINC is the weighted (by population) fraction of districts that were deemed constrained by this criterion. It takes a value of zero if the SMSA is in a state without this type of equalization program. TL is similar, except that in states that have property tax limits it is the fraction of districts in the SMSA that have tax rates two standard deviations above the average tax rate. Other cutoff values were tried, but the two standard deviation measures gave the best fit.

The analysis in section 2.5 predicts that the coefficients on REVINC and TL will be positive. The coefficient on AID will be negative, as long as there are accompanying requirements forcing a minimum increase in expenditures.

PCATH, the percentage of Catholics in the SMSA, is the only variable in the private school equation that has no connection to the Tiebout hypothesis. It is included because religious instruction is not available in public schools and Catholic institutions constitute the bulk of religious private schools. The percentage Catholic should have a positive influence when the dependent variable is the percentage in religious private schools. It is not expected to be significant when the dependent variable is the percentage in secular private schools.

3.2 The Expenditures per Pupil Equation

Nearly every empirical study of private school enrollment includes expenditure per pupil as an explanatory variable. However, very few treat it as endogenous even though there is a large literature attempting to explain the variation in this variable across jurisdictions and over time. Similarly, in the expenditure literature, private school enrollment appears in the equation, but is treated as if it is exogenous. These omissions may lead to simultaneity bias of all of the estimates.[5]

Aside from the modeled simultaneity, this expenditure equation is similar to others in the literature with respect

to independent variables and the log-log functional form (Megdal (1984), Gustman and Pidot (1973), Denzau and Grier (1984) and Lovell (1978)). One other difference is the inclusion of the tax and revenue increase limitation variables. The only studies that have taken account of the effects of equalization policies are Megdal (1983, 1986).[6]

$$\begin{aligned}\text{LNEXPEND} = {} & b_0 + b_1\text{LNMEDY} + b_2\text{LNSKEW} + b_3\text{LNOOCC} + \\ & b_4\text{LNAVGED} + b_5\text{LNAID} + b_6\text{LNPH65} + b_7\text{LNPRIV12P} + \\ & b_8\text{REVINC} + b_9\text{TL} + b_{10}\text{LNAVGKIDS} + b_{11}\text{LNCRIME81} \\ & + b_{12}\text{JAN} + b_{13}\text{JAN}^2 + b_{14}\text{JULY} + b_{15}\text{JULY}^2 + u_2\end{aligned}$$

The median voter chooses the level of expenditures.[7] Since education is a normal good, the higher median income in a school district the higher the instructional expenditures per pupil. LNMEDY is the log of median family income in the school districts averaged to the SMSA level. b_1, the income elasticity of expenditures, will be positive.

LNPRIV12P is the predicted value of the log of the percentage of students in both types of private schools. The anticipated sign on the coefficient of LNPRIV in the current expenditures per pupil equation is not known _a priori_. As the proportion of students attending public school falls, the cost to the median voter of raising educational quality falls, causing expenditures per pupil to increase. This was shown in Chapter 2. However, if wealthy households send their children to private school, it is quite likely that they will vote with those who are on the low end of the income distribution against higher

expenditures. This will result in a new decisive voter, with less than median income. However, he will choose a lower expenditure level per pupil than the voter with median income only if the income elasticity of demand for public education is greater than the elasticity of substitution between public and private education (See note 2.7). If this is the case it is not clear what will happen to expenditures per pupil on net. Only the former effect will be present if utility is Cobb-Douglas.

LNPH65 and LNAVGED are control variables in the equation. LNPH65 is the log of the percentage of households headed by people over 65. Just as LNPRIV12P, the effect of this variable will depend on the relative magnitudes of the elasticities of income and substitution. No matter what their position in the income distribution, most people over 65 have no direct interest in the quality of education. They will desire lower expenditures, which will result in a different decisive voter with less than median income.

LNAVGED, the log of average educational attainment, is expected to have a positive effect on expenditures per pupil. Those with high levels of education may have a taste for high quality of public schooling beyond what income alone would predict. There is also an efficiency effect associated with LNAVGED. As parental education rises, the cost of producing child quality falls, increasing the demand for it and its inputs. However, if the efficiency of parents time is raised more than that of school inputs,

there will be an offsetting substitution away from school inputs.[8]

LNSKEW is the log of median divided by mean income for each school district averaged to the SMSA. This variable measures the price the median voter must pay. As rightward skewness increases (median income falls relative to mean income) in a school district the median voter faces a lower price per unit of education, because he is being subsidized by his wealthy district. As the price falls the median voter will spend more per pupil. b_2 will be negative.

LNOOCC, the log of the percentage of homes that are owner occupied is also a price variable. Studies have shown that renters perceive property taxes being shifted from themselves to owners. Owners have the same perception. If this is the case, then an increase in LNOOCC should reduce expenditures per pupil.

LNAVGKIDS again measures the quality quantity tradeoff of raising children. It was shown in Chapter 2 that 'n' affects the cost of providing a unit of quality in the public schools. The higher the average number of children per family the lower expenditures per pupil.

LNCRIME81, JAN, and JULY are variables measuring location amenities that are included to capture compensating wage differentials for teachers. Most of what is included in the dependent variable is teachers' salaries. As the cost of teachers increases, expenditures per pupil will increase if the demand for education is price inelastic.

LNCRIME81 is the log of the crime rate for the SMSA in 1981. JAN and JULY, average temperatures in January and July, enter the equation in quadratic form. In their study, Kenny and Denslow (1980) found that higher crime rates are reflected in higher teacher salaries, while higher January and July temperatures lowered salaries.[9] They also found that the relationship is not monotonic. July temperatures can get too high, resulting in higher salaries.

LNAID, REVINC, and TL are the policy variables in the expenditure equation. Nearly all of state aid distributed in 1980 was in the form of nonmatching state block grants. These grants have a pure wealth effect unless there are strings attached. In order to ensure that some local money goes toward school quality, minimum tax rates, which are required for a district to receive state aid, have been imposed in some states.

Everything else constant, SMSAs with districts bound by taxation or revenue increase ceilings will be able to spend less per pupil than those not bound by such limits. If two SMSAs have the same median income, price variable, etc., but one has districts that are constrained by tax limits and the other does not, the SMSA with constrained districts will have lower per pupil expenditures.

3.3 The Income Heterogeneity Equation

$$\begin{aligned}\text{LOVERMED} = {} & c_0 + c_1\text{AVGAREA} + c_2\text{JURISP} + c_3\text{HERSMSA} + \\ & c_4\text{STATESH} + c_5\text{VARSMSA} + c_6\text{PCHANGE} + c_7\text{P18} + \\ & c_8\text{REVINC} + c_9\text{TL} + u_3\end{aligned}$$

The final two equations were influenced by an article by Eberts and Gronberg (1981) which tested the Tiebout hypothesis. Using a sample of 34 SMSAs, they found that the incentives for households to sort themselves into homogeneous districts is a function of the degree of choice among districts with respect to the provision of public education, measured by the number of districts, and the heterogeneity in the entire SMSA. In their analysis they used Theil's entropy measure to calculate the percentage of income variation in the SMSA that was explained by within school district variation. Their independent variables were similar to those used in the above equation with the exception of the equalization variables. They found that the number of school districts in the SMSA, the racial composition of the SMSA, the average size of the SMSA's districts, and recent migration to the SMSA affect the variation of income within the SMSA. Many of the variables discussed below were used by Eberts and Gronberg (1981).

The more school districts the more choice there is in the SMSA. This makes it easier for families to sort by income across districts. A given SMSA's income distribution can be divided into smaller segments the greater the number of districts. This will reduce the variation of income in the representative district. JURISP is the actual number of school districts when the SMSA is in a state that requires school district and county boundaries to coincide. It is the antilog of the predicted value from the number of

jurisdictions equation (See section 3.4) for all other SMSAs.

Holding the number of school districts constant, the larger the variance of income for the entire SMSA the larger the variation of income within each district. VARSMSA will have a positive effect on OVERMED.

The greater the percentage of the population that is of school age, P18, the more reason families have to sort by income. This effect may not be very large since there are other public goods being provided by local governments. The expected sign on c_7 is negative.

As HERSMSA, a racial Herfindahl index at the SMSA level, gets larger there is more racial homogeneity in the SMSA as a whole. In more racially homogeneous SMSAs, sorting by income is not as likely to be obscured by racial sorting. c_3 is expected to be negative.

It was noted earlier that, in order to equalize spending per pupil, states have been increasing their share of local revenues raised to fund public education. As the state's share of revenues increases, the variation of quality available in the public schools will decrease. STATESH, the fraction of state revenues divided by all revenues in the district, is expected to have a positive coefficient. TL and REVINC, holding the state's share constant, should also reduce the variation in school quality and should all have positive coefficients.

The costs of locating within the SMSA in another district that provides a quality of education closer to that desired by the household will be higher in a geographically large school district. First, it costs more to find the new, more desirable district. Secondly, if jobs are not changed at the same time the school district is, it is likely that commuting costs will rise. All of this means less mobility and more heterogeneity in the larger districts. AVGAREA, square miles of the SMSA divided by number of districts, is expected to have a positive coefficient.

New families add to within district heterogeneity simply because they do not know the area well enough to be able to choose the district best suited for their needs. Trial and error is a costly process, so they will wait for some time before picking a new, more appropriate, district. PCHANGE is the fraction of people who did not live in their present SMSA five years earlier. It will have a positive coefficient.

3.4 The School District Equation

Eberts and Gronberg explained the number of jurisdictions solely by dummy variables for each of the eight states in which their sampled SMSAs were located. This approach explained sixty percent of the variation in the dependent variable. In this section an equation is presented that relies on demographic, economic, and policy variables to explain the differences in the number of school

districts across SMSAs. The log-log functional form was chosen over the linear form based on the results of the BM test as described in Maddala (1988). The sample size is only 113 SMSAs, rather than the 134 SMSAs used to estimate the other three equations. SMSAs in states that require school district and county boundaries to coincide are excluded since the number of jurisdictions is not endogenous in this case.[10]

$$\text{LNJURIS} = d_0 + d_1\text{LNVARSMSA} + d_2\text{LNPOP} + d_3\text{LNPURBAN} + d_4\text{LNSTATESH} + d_5\text{TL} + d_6\text{REVINC} + u_4$$

There are two competing forces that affect the number of districts within an SMSA. First there are cost savings from having fewer districts per person in the presence of economies of scale. Larger values of demographic variables that make scale economies easier to achieve, such as the percent urban, PURBAN, will lead to fewer districts, holding population constant[11]. The sign of d_3 is expected to be negative. Similarly, a larger population can support more districts, which implies d_2 should be positive.

On the other hand, there are benefits of sorting into homogeneous school districts in order to efficiently provide public education. The greater these benefits the greater the demand for more and smaller districts. Government policies aimed at equalizing the quality of education across districts reduce the gains to sorting. In SMSAs where the state contributions account for a large share of district

revenues we can expect fewer districts. Tax and expenditure limitations should produce a similar effect.

As the variance of income in the SMSA as a whole increases, more districts are necessary, holding population constant, to achieve the same degree of income homogeneity. d_1 is expected to be positive.

3.5 Data Sources and Sample Selection

For the 1970 and 1980 censuses, the National Center for Educational Statistics (NCES) developed a unique set of school district maps. These maps made it possible to identify the census areas within each district. When the boundaries did not coincide they used appropriate approximations. A conversion tape was developed, so that the information available in the 1970 and 1980 Census of Population and Housing summary tapes could be retabulated by school district. The 1980 census tape by school district is the source for the following variables: OVERMED, LNMEDY, |WC-BC|, HERRACE, LNPRIV12, AVGKIDS, LNSKEW, JURIS, LNAVGED, LNOOCC, LNPH65, PCHANGE, HERSMSA, VARSMSA, LNPOP, and REVINC.

The Survey of School District Finances, 1979-1980, which was performed by the NCES and made available through the Census Bureau, contains data on revenue by source and expenditure by type for all public school districts in the United States. This survey was taken every school year between 1973 and 1979. Data for the state funding variable, most of the data necessary to construct TL, and expenditures per pupil are available on this tape.

PCATH, the percentage of Catholics, was calculated from Churches and Church Membership, 1982. The percentage of Catholics, and all other religious members, is available for each county in the United States. Each district was assigned the percentage given for its county. Then a weighted average was taken.

The rate of 'serious crime' for metropolitan areas was taken from the County and City Data Book 1983.

Information on whether or not a property tax or revenue increase limit existed in 1980, was gathered by writing to the fifty states' Departments of Revenue, or equivalent agency and by utilizing the literature on equalization policies that take a case study approach.

The 134 SMSAs in the sample are listed in Appendix B. They were chosen from the 318 SMSA's in the United States because data was available for them on all variables. Data difficulties arose for the remaining SMSAs for various reasons.

A number of SMSAs were deleted because information on either the existence or type of expenditure equalization policy was not known because its state was one of the approximately one third that did not reply to my inquiries. Others were deleted because they were omitted from one or both of the data tapes. The Census tape, for example, was missing SMSA information for the New England States. Another problem that further limited the sample was that the Census and NCES counted vastly different numbers of school

districts for quite a few SMSA's. Honolulu, Hawaii, for instance, had one school district according to NCES and over 100 according to Census. It was often impossible to determine which source was correct, since the government only publishes statistics on school districts with over 5000 students. Even if it were possible to know the correct number of districts, the problem of determining which districts should be added together or deleted was not able to be solved given the identifying information for each district on the two tapes.

Because of these irregularities, special care was taken to verify the data on the tapes. For the Census tape, school districts were summed to the county and SMSA levels. These totals were compared to figures in the published 1980 Census. For the NCES tape, expenditure figures were checked against the published school district census for large districts. No discrepancies resulted from these checks.

3.6 End Notes

1. Two Stage Least Squares (2SLS) is not used because of the nonlinearities introduced when the variables appear in different functional forms on the right and left hand sides of the equations.

2. See 2.3 for a proof of the existence of a breakeven level of income when Cobb-Douglas utility is assumed and section 2.4 for the role of income dispersion.

3. Most of the variables used were first calculated at the district level, then averaged up to get a single value for the SMSA. A weighted average was taken with district population as the weight.

4. See section 2.3 and figure 2.1.

5. Evidence against this bias is in Lovell (1978). He treats PRIV as endogenous in an expenditure regression and

finds no significant difference between the coefficients of the OLS and simultaneous estimations.

6. Megdal (1986) looks at the impact that New Jersey's equalization policies have had on expenditures.

7. The median voter's choice of education quality is described in section 2.2.

8. See Kenny (1982).

9. Other variables that were found to significantly affect teachers' salaries, such as class size, were not available for the sample.

10. A Chow Test confirmed the difference between these two types of SMSAs at the 1 percent level of significance.

11. See Kenny (1982).

CHAPTER 4
EMPIRICAL RESULTS

The four equation system presented in Chapter 3 is estimated using the instrumental variables technique. The range of the dependent variables for the private school enrollment equation and the income heterogeneity equation are limited between zero and one, so they are estimated using the logistic functional form.[1] The regressions for these two equations are corrected for the resulting heteroscedasticity.[2]

The unit of observation is the "average" school district for the 134 SMSAs in this sample.[3]

4.1 The Private School Enrollment Equation

The private school equations are estimated by Two Stage Least Squares (2SLS). The results for the two private school enrollment dependent variables are presented in Table 4.1.

One important thesis in this dissertation is that the variation of income in a school district, rather than the level of income, determines the fraction of students in private schools. In Chapter 2 a theory was developed that predicted that the greater the variation of income, the greater the percentage of children enrolled in private schools. OVERMED is a measure of income variation in the SMSA's representative district. It is the percentage of families with at least twice median income. OVERMEDP's

Table 4.1
Results for the Private School Logit Equations (K-12)

DEP:	LSEC12	LREL12
INTERCEPT[a]	-1.6778	-1.6287*
	(1.452)	(1.674)
OVERMEDP	6.2416*	-5.4930
	(1.388)	(1.356)
HERRACE	-2.9541***	- .7049*
	(5.593)	(1.459)
WCBC	.6619	- .7598
	(.770)	(1.013)
MEDY	- .000024	7.281×10^{-6}
	(.838)	(.339)
EXPENDP[a]	.00086***	.00046**
	(3.429)	(2.202)
AVGKIDS	-1.8633***	-.1773**
	(3.525)	(1.866)
PCATH	- .9153**	1.9347***
	(2.157)	(5.849)
AID	- .000862***	- .000435***
	(4.532)	(2.580)
TL[a]	- .9467**	- .6465**
	(2.542)	(1.971)
REVINC	4.4634***	3.2184**
	(2.629)	(1.738)
$\bar{R}^2$ =	.4980	.4917

t-statistics in parentheses
* significant at the .10 level
** significant at the .05 level
*** significant at the .01 level
[a] two tailed test of significance

coefficient is significant with the expected positive sign when the percentage of children enrolled in secular private schools is the dependent variable. It is not surprising that the composite null hypothesis, that income variation has a negative effect or none at all, is rejected only for the secular equation. Parents are likely to choose a secular private school because they desire a higher quality of education than that offered in the public schools. They are more likely to choose a religious private school because they want a values oriented or religious education for their children. The model in Chapter 2 was formulated only with the secular private school student in mind.

In contrast, median income does not significantly affect private school enrollment in either enrollment equations. Other studies have reported a significant coefficient on the median (or average)income variable, but the authors did not control for the variation of district income.[4] The regressions were also run without median income, as indicated by the theory. There was no significant difference in the results.

The coefficients on the variable that accounts for racial heterogeneity in the average district is consistent with the prediction made in Chapter 3. The greater the degree of racial homogeneity the smaller the percentage of students in private schools. Both religious and secular schools appear to be used by parents to avoid racially diverse public schools.

A greater degree of occupational heterogeneity (a smaller value of WCBC) was expected to increase enrollments, however it does not have a significant effect on private enrollments in either equation.

The next two variables, EXPENDP and AVGKIDS, capture the costs of sending children to private schools. In Chapter 2, public school expenditures per pupil represented the fixed cost of private school enrollment per child. The quality, measured in dollars, of the private school must be at least that of the public school. The expected sign on EXPENDP's coefficient is negative. An increase in expenditures per pupil in the public schools is expected to reduce private school enrollment. In the private school regressions, however, it has a positive sign. Although the wrong sign, this result is not totally unexpected. In a number of private school studies the coefficient on this variable has been reported to be positive.[5] One possible explanation for this result is the role of compensating wage differentials for teachers. EXPEND is almost entirely salaries. In order to attract teachers to districts with poor students, discipline problems, etc., school districts must offer higher salaries. This will lead to a higher value of EXPEND. These will be the same districts where the low quality of public school may lead to more families opting for the private alternative.

As the average number of children per family increases, the percentage in private school falls dramatically. Each

additional child per family with children is associated with a decline in the percentage of children in both secular and religious private schools of nearly two percentage points.

The coefficient on the percentage of Catholics in the SMSA is positive and significant for religious enrollments. It is significantly negative for secular private schools. These results were expected.

AID, TL, and REVINC are the policy variables in the equation. The coefficient on AID is significantly negative for both secular and religious schools, indicating that there are often strings attached to state aid.

REVINC and TL are proxy variables for the percentage of districts facing binding revenue increase and tax rate limitations, respectively. As these percentages increase, enrollments are expected to rise. Enrollments do rise significantly with REVINC for both types of private schools. However, TL's coefficient is consistently significantly negative.

4.2 The Expenditure Per Pupil Equation

Table 4.2 contains the results of the equation explaining public school expenditures per pupil.

The variables with significant coefficients have the expected signs and magnitudes that jibe with the existing literature.

The median voter is choosing the level of expenditures. The positive coefficient on LNMEDY, the log of median income,

Table 4.2
Results for the Expenditure per Pupil Equation

DEP: LNEXPEN

INTERCEPT[a]	-4.2843** (1.890)	LNAID	.3546*** (6.773)
LNMEDY	.4833*** (3.577)	TL[a]	.2138** (2.464)
LNPRIV12P	.1767*** (4.634)	REVINC	-1.165*** (2.859)
LNSKEW	-1.1613** (2.469)	LNAVGKIDS	- .0512 (.537)
LNEDAVG	.2192 (.776)	LNCRIME81	.0391 (1.128)
LNOOCC	.1081 (1.236)	JULY	.1113*** (3.172)
JAN	- .0028 (.575)	$JULY^2$	- .0007*** (3.248)
JAN^2	-1.63×10^{-5} (.264)		

$\bar{R}^2 = .7282$

t-statistics in parentheses
* significant at the .10 level
** significant at the .05 level
*** significant at the .01 level
[a]two tailed test of significance

indicates that education is a normal good. The elasticity of .4833 is within the range of past studies.[6] It is significantly different from one, however, indicating that preferences are not Cobb-Douglas. Also, it is unlikely that the elasticity of substitution is lower than this income elasticity. This result affects the interpretation of the coefficients on LNPRIV12P and LNP65.

The the signs of the coefficients on the variables measuring the percentage in private school[7], and the percentage of households headed by a person older than 65 were indeterminate before the regression was estimated due to two competing effects. First, if wealthy families that are sending their children to private schools form a coalition with poor families the median voter will have less than median income.[8] Expenditures per pupil will be lower than if no coalition exists, so long as the income elasticity is larger than the elasticity of substitution. The coefficient on LNPRIV12P will be negative. Alternatively, it was shown in Chapter 2 that the decisive voter will choose higher expenditures per pupil as the number of students in public school falls. This second hypothesis is supported by significantly positive coefficient generated by the sample data. Further, the low income elasticity is evidence against the former effect. It is also consistent with the insignificant coefficient on LNP65. A coalition between the elderly and poor does not affect expenditures.

The insignificant positive coefficient on LNOOCC is unexpected. Previous studies have found that home owners perceive a higher property tax burden than tenants. There is no evidence of that perception in this sample.

The coefficient on LNAID is significantly positive, but the elasticity is quite low. A one percent increase in lump sum aid leads to only a .3546 percent increase in expenditures per pupil. A good deal of aid appears to go toward tax relief rather than education.

Average educational attainment does not affect expenditures per pupil. It appears that the substitution and output effects associated with parents' education offset each other.

In the theoretical chapter, skewness is a measure of price. The greater the ratio of median to mean income, the more expensive is a unit of publicly provided educational quality. The importance of this variable was first demonstrated by Lovell (1977). The negatively significant coefficient on LNSKEW supports the theory.

REVINC significantly reduces expenditures per pupil, as expected. SMSA's with a greater proportion of districts bound by revenue limitations will have lower spending. TL, on the other hand, has a positive, and nearly significant coefficient.

LNCRIME81, JULY and JAN were included in the regression to capture compensating wage differentials. It was expected that in high crime SMSA's teacher compensation would also be

high. While the sign is positive, the coefficient is insignificant. January temperatures do not have a significant effect on expenditures. Evaluated at the mean, July temperatures are positively correlated with expenditures. Others have found that teacher salaries are lower in areas with warm summer temperatures. This result here is consistent with other findings if the price elasticity is greater than one, in this sample.

4.3 The Income Heterogeneity Equation

Table 4.3 contains the results for the income heterogeneity equation. The dependent variable is LOVERMED, the log of the fraction of families with at least twice median income in the SMSA's representative district divided by the fractions with lower incomes. The explanatory variables in this equation are similar to those used by Eberts and Gronberg (1981) to test the segregation aspect of the Tiebout hypothesis.[9] Many of the variables describing SMSA or district characteristics are included because they affect the costs and benefits of shopping for a district and moving. The results presented here differ considerably from their findings.

I expected the number of school districts to have a negative coefficient. Families in the SMSA are better able to sort when there are more districts to choose from. This was one of the main hypotheses tested by Eberts and Gronberg. It was strongly supported by their data. In this regression, though, while the coefficient was negative the

Table 4.3
Results for the Heterogeneity of Income Logit Equation

DEP: LOVERMED

INTERCEPT[a]	-1.6354***
	(7.159)
JURISP	- .0002
	(.588)
PCHANGE	.5632***
	(2.732)
STATESH	.1065
	(1.037)
AVGAREA	.00002
	(1.055)
SMSAHER	- .8479***
	(8.901)
REVINC	.3276
	(.549)
TL	- .0582
	(.584)
P18	- .4074
	(.569)
VARSMSA	3.89×10^{-11}
	(.302)

$\bar{R}^2 = .5286$

t-statistics in parentheses
* significant at the .10 level
** significant at the .05 level
*** significant at the .01 level
[a]two tailed test of significance

t-statistic is less than one. One possible explanation for the difference in our results is the choice of districts in the sample. Eberts and Gronberg only included unified districts, while I include unified, elementary and secondary. Since a number of elementary districts are associated with one secondary districts, the total number of districts, and hence the amount of choice of public school quality in the SMSA, may appear larger than it actually is.

Holding the number of districts constant, it was expected that the larger the variation of income in the SMSA as a whole, the larger the variation of income in the representative district. VARSMSA's coefficient has a t-statistic close to zero, however.

A larger average school district was expected to associated with a larger degree of income heterogeneity within the average district. The coefficient is insignificant.

Equalization policy variables have not been used previously to explain income heterogeneity. Both variables were expected to have positive coefficients. The more districts that are constrained by limits on either tax rates or the rate of revenue increases, the less choice among jurisdictions, holding the number of districts constant. Both of these variables are insignificant with t values less than one. TL again has the unanticipated sign.

The fraction of revenues contributed by the state was included for the same reason as REVINC and TL. States

contribute to school districts in order to reduce variations in local spending. Again, choice among districts will be reduced. In this case the coefficient is positive, but insignificant. Eberts and Gronberg found a significant effect.

HERSMSA is the Herfindahl index for the four ethnic/racial groups used to construct HERRACE, but calculated on the SMSA level, instead of the district level. As HERSMSA approaches its maximum value, one, the SMSA becomes more homogeneous with respect to race. The negatively significant coefficient means that families are better able to sort by income in racially homogeneous SMSAs.

The insignificant coefficient on P18 means that districts in SMSAs with a high fraction of the population younger than eighteen are not more homogeneous with respect to income.

The percentage of families that are new to the SMSA has a positive coefficient. It takes time to learn about the school districts in an area. This is also consistent with Eberts and Gronberg.

The support for the Tiebout hypothesis from this equation is mixed, at best. The of percentage of families new to the SMSA has a significant coefficient consistent with the Tiebout hypothesis. The number of school districts, the fraction of districts bound by tax limits and revenue increase restrictions, the percentage over eighteen,

and the size of the state's contribution, do not explain the variation in income heterogeneity across districts.

4.4 The Number of Districts Equation

Eberts and Gronberg found that the number of school districts in an SMSA is endogenous. They used the instrumental variables technique for the number of jurisdictions. Their instruments were dummy variables that represented the SMSA's state. The equation estimated in this paper uses variables that affect the competing forces of cost savings that result from economies of scale, which lead to a few large districts, and the Tiebout hypothesis, which lead to a large number of homogeneous districts. The results are presented in Table 4.4.

A number of states, particularly in the South, have laws that restrict school districts to county borders. SMSAs in these states will have significantly fewer districts on average, than SMSAs in states without such a law. Since the number of districts in these SMSAs is not endogenous they were eliminated from the sample. This equation was estimated with 113 SMSAs.

State aid and tax and revenue limitations narrow the differences among school districts. The first two of these variables limit the effect of the Tiebout hypothesis in the SMSA and significantly reduce the number of school districts in the SMSA. REVINC's negative coefficient is insignificant.

Table 4.4
Results for the Number of School District Equation

DEP: LNJURIS

INTERCEPT[a]	-16.3378***
	(2.901)
LNVARSMSA	.3385*
	(1.334)
LNPOP	.8310***
	(12.502)
LNSTATESH	- .5598***
	(2.395)
LNSMSAHER	- .1206
	(.397)
LNPURBAN	-1.6531***
	(3.767)
REVINC	-2.0696
	(.865)
TL	- .7665**
	(1.890)

$\bar{R}^2 = .6436$

t-statistics in parentheses
* significant at the .10 level
** significant at the .05 level
*** significant at the .01 level
[a]two tailed test of significance

Economies of scale with respect to school district size are easier to exploit in more urban SMSAs as the coefficient on LNPURBAN suggests.

A minimum population size is needed to support a school district and exploit economies. The larger the population of the SMSA the more school districts. The number of districts increase less than proportionately, since the coefficient on LNPOP is significantly less than one. This is consistent with large metropolitan areas being more densely populated and having larger school districts.

The greater the variation in income in the SMSA as a whole, the greater the demand for additional schools districts in which to sort. This conjecture is supported by the data. The coefficient on VARSMSA is positive and significant at the ten percent level.

4.5 End Notes

1. The logistic functional form is used instead of the Linear Probability Model (LPM), because several of the observations had negative predicted values of SEC12 with the LPM model. The predicted values represent probabilities. There was no difference in the results of the logistic versus LPM when REL12 and OVERMED were the dependent variables.

LPM coefficients can be approximated by the logistic model at the mean by solving for p by finding ln(p/(1-p)). Then using the following formula:

$$\frac{\delta p}{\delta x_i} = \beta_{logit}(1-p)p$$

2. See Gujarati (1988) p. 486 for the appropriate weights to correct the logit model for heteroscedasticity.

3. The data used was collected at the school district level. The variables is the regressions were calculated at the district level and then averaged to the SMSA level. The observation for each SMSA is for the representative, though

nonexistent school district.

4. For examples see Gemello and Osman (1984), James (1987), Long and Toma (1988), and Sonstelie (1979). Martinez-Vazquez and Seaman (1985) use the percent of families with 1970 incomes above 25,000, which is another income level variable.

5. Two papers that report positive coefficients on expenditures per pupil are Ereckson (1982) and James (1987).

6. Denzau and Grier (1984) estimated 4096 specifications of the equation explaining current per pupil expenditures with a common data set consisting of 506 unified districts in New York in 1970-71. The purpose was to examine the robustness of estimates in the existing literature. The coefficient's value, .5087, falls into their range.

For empirical tests of the median voter hypothesis see Inman (1978b) and Gramlich and Rubinfeld (1982).

7. It was not necessary to estimate this equation for each type of private school. When looking at expenditures per pupil in public school the issue is the fraction of students living in the district who are not attending.

8. See section 2.7 note 4.

9. Eberts and Gronberg's (1981) dependent variable is the proportion of total SMSA income variation accounted for by the variation within unified school districts. Thiel's decomposable entropy variable was used to find this proportion. The independent variables are the number of unified districts, the average size of the districts (in terms of population), the number of families in the SMSA, STATESH, PURBAN, the fraction nonwhite, PCHANGE, P18, and VARSMSA. The equation was estimated with 1970 census data.

CHAPTER 5
SUMMARY AND CONCLUSIONS

A theoretical model was developed that showed the relationship between the Tiebout hypothesis and private school enrollment. As the variance of income increases and the school district becomes more heterogeneous, private school enrollments increase. Changes in mean income alone, on the other hand, do not effect enrollments. This relationship was tested with school district data for 134 SMSAs. The data supported the theory when the fraction in secular private schools was the dependent variable.

Another type of heterogeneity also affected the fraction in private schools. Racial heterogeneity raised enrollment in both secular and religious private schools.

By relating the Tiebout hypothesis to private school enrollment, the importance of structural characteristics of the SMSA on the private/public choice becomes evident. Characteristics that lead to more heterogeneity will raise the fraction in private schools. This linkage is new to the literature.

An equation explaining the heterogeneity of income in the SMSA's representative district was estimated. The equation was founded on the Tiebout hypothesis and work by Eberts and Gronberg (1981). The number of jurisdictions failed to reduce the level of income heterogeneity as the Tiebout hypothesis predicted. Supporting Tiebout were the

results that the more new families in the SMSA and the larger the average geographic size of districts, the greater the variation of income.

Another aspect of the theory that was tested was the role of expenditure equalization policies. Both policies that place limits on the median voter's choice of expenditures were expected to result in increases in private school enrollment, reductions in expenditures per pupil, and increases in the variation of income in the typical district. The policies were measured using the proxy variables REVINC and TL. The rate of revenue increase had the expected effect in each equation. The effect was significant for secular private school enrollment, expenditures, and the number of districts equations. TL, on the other hand, had a coefficient with the unexpected sign in all but the number of districts equation. Its effect is significant in the two private school equations. The higher the percentage of bound districts the smaller the percentage in both religious and secular private schools. This may reflect its shortcoming as a proxy.

Lump sum aid was found to reduce private school enrollments and increase expenditures per pupil. The effects of a foundation program differ considerably from equalization programs that put limits on district spending. Revenue increase limitations increased private enrollments. Assuming the state's goal of expenditure equalization can be achieved with either foundation program or limits on revenue

increases, those who are concerned about public enrollments should favor foundation programs.

The number of school districts equation was the first attempt in the literature to empirically investigate the economic and demographic determinants of jurisdictions. It was found that policies that reduce quality differences across districts, and therefore the benefits of having small districts, reduce their number. Variables that reduce the cost of exploiting economies of scale, such as the degree of urbanization, also reduce the number of districts. This provides evidence of conflicting economic forces affecting the number of jurisdictions in a metropolitan area.

APPENDIX A
SOURCE AND CONSTRUCTION OF VARIABLES

PRIV12 = fraction of students in grades K-12 enrolled in private school (Census)

SEC12 = fraction of students in grades K-12 enrolled in secular private school (Census)

REL12 = fraction of students in grades K-12 enrolled in religious private school (Census)

WCBC = |WC-BC|; WC is the fraction white collar and BC is the fraction blue collar (Census)

OVERMED( ) = O1-O40; the fraction of families with income some fraction above the median family's income. OVERMED1 is the fraction of families with incomes 5 percent above median. OVERMED20 is the fraction of families with income 100% above. OVERMED in the text refers to OVERMED20. (Census)

HERRACE = sum of squared shares of four "racial" groups (Black, white, asian, and hispanic). Calculated at the school district level and averaged. (Census)

AID = Lump sum state aid per pupil. (NCES)

REVINC = 1 if population growth in the county is greater by two standard deviations above population growth in the state. 0 otherwise. Averaged up to the SMSA level. (Census)

TL = 1 if the tax rate in the district is two standard deviations above its state's average tax rate. 0 otherwise. Averaged up to the SMSA level. (NCES)

AVGKIDS = the number of children in the district divided by the number of families with children. Then averaged to the SMSA level. (Census)

EXPEND = expenditures per pupil in the public schools. Calculated at the school district level and then averaged up. Operational expenditures net of transportation. (NCES)

PCATH = fraction of the population at the county level that are Catholic. Averaged up to the SMSA. (Churches and Church Membership 1980)

MEDY = median family income (Census)

SKEW = median family income/mean family income (Census)

OOCC = fraction of houses that are owner occupied (Census)

AVGED = average education level of people 25 years and older. (Census)

CRIME81 = the number of serious crimes per 100,000. (County and City Data Book)

JAN = the average temperature in January over a twenty year period. (Climates of the States)

JULY = the average temperature in July over a twenty year period. (Climates of the States)

PH65 = fraction of the population 65 and older. (Census)

AVGSIZE = Area of the SMSA/# School Districts. (Census, NCES)

STATESH = State Aid/Total Revenue. (NCES)

PCHANGE = percentage of people who did not live in the same SMSA in 1975. (Census)

HERSMSA = sum of squared shares of four "racial" groups. Calculated for the SMSA as a whole. (Census)

JURIS = the number of school districts in the SMSA. (NCES)

POP = number of people living in the SMSA. (Census)

VARSMSA = variance of incomes for the SMSA as a whole. (Census)

COUNTY = 1 if the state in which the SMSA is located requires county and school district boundaries to be identical. 0 otherwise. (Census)

APPENDIX B
SMSAS IN THE SAMPLE

Boise City, ID
Brownsville, TX
Bryan-College Station, TX
Buffalo, NY
Canton, OH
Cedar Rapids, IA
Champaign, IL
Charleston, SC
Charleston, WV
Chattanooga, TN (GA)
Chicago, IL (IN WI)
Cincinnati, OH (KY WV)
Cleveland, OH
Columbia, MO
Columbia, SC
Columbus, GA
Corpus Christi, TX
Davenport, IA (IL)
Dayton, OH
Daytona, FL
Decatur, IL
Duluth, MN
El Paso, TX
Elmira, NY
Erie, PA
Eugene, OR
Fargo, ND (MN)
Fayetteville, AK
Ft. Lauderdale, FL
Ft. Myers, FL
Fresno, CA
Gainesville, FL
Galveston, TX
Green Bay, WI
Greenville, SC
Hamilton, OH
Huntington, WV
Jackson, MS (KY OH)
Jacksonville, F
Jersey City, NJL
Johnstown, PA
Kansas City, MO (KS)
Kenosha, WI
Knoxville, TN
La Crosse, WI
Lakeland, FL
Lancaster, PA
Laredo, TX
Las Vegas, NV
Lincoln, NE
Little Rock, AR
Long Branch, CA
Lorain, OH
Los Angeles, CA
Lubbock, TX
Lynchburg, VA
Macon, GA
Madison, WI
Mansfield, OH
McAllen, TX
Melbourne, FL
Memphis, TN (AR MS)
Miami, FL
Modesto, CA
Nashville, TN
Nassau-Suffolk, NY
New Brunswick, NJ
Newark, NJ
Newport News, VA
Northeast PA
Odessa, TX
Orlando, FL
Oxnard, CA
Parkersburg, WV (OH)
Paterson, NJ
Pensacola, FL
Peoria, IL
Petersburg, VA
Philadelphia, PA (NJ)
Phoenix, AZ
Pine Bluff, AK
Pittsburgh, PA
Poughkeepsie, NY
Provo, UT
Racine, WI
Reading, PA
Reno, NV
Richland, WA
Richmond, VA
Riverside, CA
Roanoke, VA
Rochester, MN
Rockford, IL

Sacramento, CA
St. Joseph, MO
St. Louis, MO (IL)
Salem, OR
Salinas, CA
Salt Lake City, UT
San Angelo, TX
San Antonio, TX
San Diego, CA
San Francisco, CA
San Jose, CA
Santa Barbara, CA
Seattle, WA
Spokane, WA
Springfield, IL
Tacoma, WA
Yakima, WA

BIBLIOGRAPHY

Barzel, Yorum (1973). "Private Schools and Public School Finance." Journal of Political Economy 64: 174-186.

Bendrick, Jr., Mark (1977). "Education as a Three-Sector Industry," in The Voluntary Nonprofit Sector. edited by Burton A. Weisbrod. Lexington Books: Lexington, MA.

Bourguignon, Francois (1979). "Decomposable Income Inequality Measures," Econometrica 47(4): 901-920.

Brown, Byron W., and Saks, Daniel H. (1983). "Spending for Local Public Education: Income Distribution and the Aggregate of Private Demands." Public Finance Quarterly 11(1): 21-45.

Buchanan, James (1965). "An Economics Theory of Clubs." Economica 32(February): 1-14.

Clotfelter, Charles T. (1976). "School Desegregation, "Tipping", and Private Enrollment." The Journal of Human Resources 11(1): 28-50.

Denzau, Arthur, and Grier, Kevin (1984). "Determinants of Local School Spending: Some Consistent Estimates." Public Choice 44: 375-383.

De Tray, Dennis (1973). "Child Quality and the Demand for Children." Journal of Political Economy 81: S70-S95.

Downs, Anthony (1957). An Economic Theory of Democracy. Harper: New York.

Eberts, Randall W., and Gronberg, Timothy (1981). "Jurisdictional Homogeneity and the Tiebout Hypothesis." Journal of Urban Economics 10: 227-239.

Ereckson, O. Homer (1982). "Equity Targets in School Finance, Tuition Tax Credits, and the Public Private Choice." Journal of Education Finance Spring: 436-439.

Flowers, Marilyn R. (1975). "The Possibility of Double-Peaked Preference Rankings for Public School Expenditures: Extension of the Barzel-Deacon Analysis." Public Choice 23: 81-85.

Gemello, John M., and Osman, Jack W. (1984). "Estimating the Demand for Private School Enrollment." American Journal of Education 92(May): 263-279.

Gramlich, Edward M., and Rubinfeld, Daniel L. (1982). "Micro Estimates of Public Spending Demand Functions and Test of the Tiebout and Median-Voter Hypotheses". Journal of Political Economy 90(3): 536-560.

Grubb, Norton W., (1974). "The First Round of Legislative Reforms in the Post Serrano World." Law and Contemporary Problems 38(3): 459-492.

Gustman, Alan L., and Pidot, George B. Jr.(1973). "Interactions Between Educational Spending and Student Enrollment." Journal of Human Resources 8(1): 3-23.

Gujarati, Damodar N. (1988). Basic Econometrics. 2nd Edition. McGraw Hill: New York.

Hamilton, Bruce, Edwin Mills, and David Puryear (1975). "The Tiebout Hyptohesis and Residential Income Segregation," in Fiscal Zoning and Land Us Controls edited by Edwin S. Mills and Wallace E. Oates. Lexington Books: Lexington, MA.

Inman, Robert (1978a). "Optimal Fiscal Reform of Metropolitan Schools: Some Simulation Results." American Economic Review 68(1): 107-122.

_____, (1978b). "Testing Political Economy's 'as if' Proposition: is the Median Income Voter Really Decisive?" Public Choice 33: 45-65.

James, Estelle (1987). "The Public/Private Decision of Responsibility for Education: An International Comparison." Economics of Education Review 6(1): 1-14.

Kenny, Lawrence W., (1978). "The Collective Allocation of Commodities in a Democratic Society: A Comment". Public Choice 33(2): 117-120.

_____, (1982). "A Model of Optimal Plant Size with an Application to the Demand for Cognitive Achievement and for School Size." Economic Inquiry 20: 240-254.

_____, with Denslow, Jr., David A. (1980). "Compensating Differentials in Teachers' Salaries." Journal of Urban Economics 7: 198-207.

Long, James E., and Toma, Eugenia F. (1988). "The Determinants of Private School Attendance, 1970-1980." Review of Economics and Statistics 70(May): 351-357.

______, (1975). "The Collective Allocation of Commodities in a Democratic Society." Public Choice 24(1): 71-92.

Lovell, Michael C. (1978). "Spending for Education: The Excercise of Public Choice." Reveiw of Economics and Statistics 60(4): 487-495.

Maddala, G. S. (1983). Limited-dependent and Qualitative Variables in Econometrics. Cambridge University Press: Cambridge.

______, (1988). Introduction to Econometrics. MacMillan: New York. pp. 179.

Martinez-Vazquez, Jorge and Seaman, Bruce (1985). "Private Schooling and the Tiebout Hypothesis." Public Finance Quarterly 13(3): 293-318.

Megdal, Sharon Bernstein (1983). "Equalization of Expenditures and the Demand for Local Public Education." Public Finance Quarterly 11(3): 365-376.

______, (1984). "A Model of Local Demand For Education." Journal of Urban Economics 16: 13-30.

______, (1986). "Estimating a Public School Expenditure Model under Binding Spending Limitations." Journal of Urban Economics 19: 277-295.

Michelson, Stephan (1974). "Reform Through State Legislatures: What is a "Just" System for Financing Schools? An Evaluation of Alternative Reforms." Law and Contemporary Problems 38(3): 436-458.

Munley, V.G. (1982). "An Alternative Test of the Tiebout Hypothesis." Public Choice 38(2): 211-217.

Oates, Wallace (1969). "The Effects of Property Taxes and Local Spending on Property Values: An Empirical Study of Tax Capitalization and the Tiebout Hypothesis." Journal of Political Economy 77(November): 957-71.

Pack, H., and Pack, J. (1978). "Metropolitan Fragmentation and Local Public Expenditure." National Tax Journal 31(December): 349-362.

Rothenberg, Jerome (1970). "Local Decentralization and the Theory of Optimal Government." In The Analysis of Public Output, edited by Julius Margolis. National Bureau of Economic Research: New York.

Sandler, Todd, and Tschirhart, John T. (1980). "The Economic Theory of Clubs: An Evaluative Survey." Journal of Economic Literature 18(December): 1481-1521.

Sonstelie, Jon (1979). "Public School Quality and Private School Enrollment." National Tax Journal 32: 343-353.

Stiglitz, J.E. (1974). "The Demand for Education in Public and Private School Systems." Journal of Public Economics 3: 349-385.

Summers, Anita and Wolfe, Barbara (1977). "Do Schools Make a Difference." Amercian Economic Review 67(4): 639-652.

Tiebout, Charles (1956). "A Pure Theory of Local Government Expenditures." Journal of Political Economy 64: 416-424.

West, Edwin G., and Passon, Halldor (1988). "Parental Choice of School Characteristics: Estimation Using State-Wide Data." Economic Inquiry 26(October): 725-740.

BIOGRAPHICAL SKETCH

Amy B. Schmidt was born in Philadelphia in 1960 and grew up in New Jersey. She majored in public affairs as an undergraduate at the George Washington University. Immediately after graduating in 1983, she entered the Ph.D. program at the University of Florida. In 1984 she received an M.A. in economics. Mrs. Schmidt spent a year at the University of North Carolina in Chapel Hill as a visiting lecturer during the academic year 1987/1988. She is currently an assistant professor at Bentley College in Waltham, Massachusetts.

I certify that I have read this study and that in my opinion it conforms to acceptable standard of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Lawrence W. Kenny, Chairman
Associate Professor of Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standard of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

David A. Denslow
Professor of Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standard of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Jonathan Hamilton
Assistant Professor of Economics

I certify that I have read this study and that in my opinion it conforms to acceptable standard of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Robert D. Emerson
Associate Professor of Food and Resource Economics

This dissertation was submitted to the Graduate Faculty of the Department of Economics in the College of Business Administration and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

August 1989

Dean, Graduate School